CREATING SUSTAINABLE COMMUNITIES
A GUIDE FOR DEVELOPERS AND COMMUNITIES

PASSIVE SOLAR DESIGN FOR NEW DEVELOPMENT

The simplest and most direct application of solar energy is the direct conversion of sunlight into low-temperature heat (up to a temperature of 212 degrees F). In general, two classes of technologies can be distinguished: *passive* and *active* solar energy conversion. *Passive* solar design refers to the use of the sun's energy for the heating, cooling and day-lighting of living spaces. In this approach, the building itself or some element of it takes advantage of the natural energy characteristics in materials and air created by exposure to the sun. Passive systems are simple, have few moving parts, no mechanical systems, and require minimal maintenance. In contrast, *active* solar energy technologies require the transport of heat through a medium and thus need components to transform and transfer the solar energy (active solar is covered in this series in a separate Fact Sheet *Active Solar Energy Technologies - New and Existing Development*).

Since optimal application of passive solar energy requires consideration of a building's orientation and thermal mass as well as window placement and ventilation, it is more practical and economically advantageous to provide for solar energy use in new building design and construction than to attempt to integrate solar energy after the fact.

Passive design is practised throughout the world and has been shown to produce buildings with low energy costs, reduced maintenance, and superior comfort. A well-designed passive solar home can reduce energy bills by 75% while adding up to 10% in construction costs. Properties offering these types of energy savings can have a clear competitive advantage over conventional construction.

Some communities in other states (e.g., New Mexico, Georgia, Oregon, Colorado) have adopted solar design requirements for new development. Typically, these design standards are incorporated as amendments to a community's general or comprehensive plan, zoning code, or subdivision regulations. Usually, they allow for future use of passive solar technologies or protect a property's solar access.

APPLICABLE NEW JERSEY GOALS AND TARGETS

Reduce projected energy use by 20% by 2020 and meet 20% of the State's electricity needs with Class 1 renewable energy source by 2020 (NJ Energy Master Plan).

Stabilize GHG emissions at 1990 levels by 2020/ Reduce emissions to 80% below 2006 levels by 2050 (E.O. 54; NJ Global Warming Response Act, P.L. 2007, c.112).

SUGGESTED ACTIONS AND STRATEGIES

- Consider Passive Solar Principles - The application of these principles can contribute significantly to the reduction of active energy demands for heating, cooling, lighting, and ventilating homes and buildings. Some of the key principles are: (a) structure should be well insulated; (b) provide for responsive, efficient heating systems; (c) orient buildings to face south; (d) avoid overshadowing by other buildings; and (e) include materials that have high heat capacity (thermally massive). The last principle also involves *thermal storage*. There are two basic thermal storage strategies using thermal mass. "Direct" thermal storage materials, such as concrete masonry or tiles, are placed directly in the sunlight so that intense solar energy enters them quickly. "Diffuse" thermal storage materials are placed throughout the building. They can absorb heat by radiation, the reflectance of sunlight as it bounces around a room, and via air heated elsewhere in the building (e.g., sunspaces and atria).

- Integrate Principles in Building Design Process - The above principles have to be considered in relation to the building design process, because they have a direct effect on the architectural appearance of the building, on the level of comfort (heat, cold, light, ventilation), and on people's experience of the building. As a design approach, passive solar design can take many forms. It can be integrated to greater or lesser degrees in a building.

- Evaluate Building Site Carefully - Characteristics of the building site are key considerations in passive solar design. The most effective designs are based on specific understanding of a building site's wind patterns, terrain, vegetation, solar exposure and other factors often requiring professional architectural services. However, a basic understanding of these issues can have a significant effect on the energy performance of a building.

- Plan Layout of Buildings/Homes Accordingly - In planning new residential developments, lots and streets could be laid out so that most of them would be on an east-west direction. Housing on these streets would be able to make better use of solar systems and passive solar designs than houses on north-south streets.

- Incorporate Passive Solar Techniques - A number of techniques can reduce energy demands with passive means:

    Low-emission double-glazed windows. In cold climates, these windows keep out the cold while allowing solar radiation to pass. In summer the windows can be shaded, and heat is kept out.

    Low-cost opaque insulation material and high insulating building elements. These elements can keep out the heat as well as the cold.

    Transparent insulation material. This material can be used to allow day lighting while keeping out the heat or cold.

    Design for natural light and ventilation.

    High-efficiency ventilation heat recovery (transfer heat in exhaust air to incoming fresh air to reduce heating demand).

    High-efficiency lighting systems and electrical appliances with automatic control. These can bring down the internal heat gain, reducing the cooling load. Advanced daylight systems can lead to 40% reduction of the energy use for lighting purposes.

- Optimize Building Energy Demand through Simulation - By carrying out detailed simulation studies, the energy demand of a building can be optimized, without affecting comfort. It has been estimated that 13% of the heat demand of buildings is covered by passive solar energy use. For optimized buildings this fraction can go up to 30% without major investments. Due to the development of better materials and powerful simulation models, passive use of solar energy is becoming the number one consideration for heating and cooling buildings.

STATE TECHNICAL/FINANCIAL ASSISTANCE

The New Jersey Energy Star Homes under the Clean Energy Program provides incentives to builders/developers to build new homes above minimum energy code to the higher Energy Star level. See: www.njenergystarhomes.com/html/consumer/what_is.html.

FURTHER INFORMATION

"Passive Solar Design" U.S. Department of Energy (DOE) Fact Sheet
www.eere.energy.gov/buildings/info/documents/pdfs/29236.pdf

"Passive Solar Heating" DOE
www.eere.energy.gov/buildings/info/design/integratedbuilding/passiveheating.html

Passive Solar Cooling" DOE
www.eere.energy.gov/buildings/info/design/integratedbuilding/passivecooling.html

"Thermal Storage" DOE
www.eere.energy.gov/buildings/info/design/integratedbuilding/passivethermal.html

"Daylighting" DOE
www.eere.energy.gov/buildings/info/design/integratedbuilding/passivedaylighting.html

"Solar Energy for Homes"
www.nesea.org/buildings/passive.html

"A Sourcebook of Green and Sustainable Building: Passive Solar Design"
www.greenbuilder.com/sourcebook/PassiveSol.html

" Green Home Building Guidelines - User Guide: Renewable Energy/Solar Heating and Cooling: Solar Space Heating and Cooling" National Association of Home Builders (NAHB) Research Center:
www.nahbrc.org/greenguidelines/userguide_energy_renewablespace.html

"Passive Solar Heating", Whole Building Design Guide, National Institute of Building Science (NIBS).
www.wbdg.org/design/psheating.php

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